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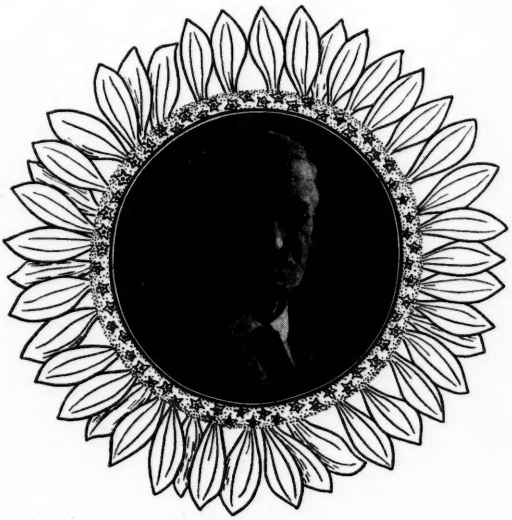

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STUDIES IN NEOTROPICAL STRATIOMYIDAE (DIPTERA)

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(Concluded from Vol. 12, No. 1).

II. The genus **Hoplitimyia** James

The genus **Hoplitimyia** was erected by the author (Ann. Ent. Soc. Amer., 27: 443-4, 1934) for the reception of **Stratiomyia constans** Loew and four related species. Johnson, in his monograph of **Stratiomyia,** had previously mentioned the distinctness of this group, but at that time did not consider it wise to propose a generic name for it. The species, so far as known, are wholly American and mostly Neotropical.

Morphologically, this genus is close to **Stratiomys,** but the individuals are wasp-like, rather than bee-like, in appearance. The head is broad, noticeably broader than the thorax, with the eyes produced laterally into somewhat of a cone; the antennae are long and seven-segmented; the first segment is usually at least five times the length of the second (less than that in only one known species), and is somewhat clavate; the third to seventh segments inclusively form a flagellum, which is expanded, usually strap-like, and without a style. The eyes are bare. The occiput is more or less concave; the face is prominent, the antennae being situated on the prominence. The proboscis is of moderate length; the labella, rigid. The scutellum is rounded behind, with two moderately strong spines which are set rather close together, and on the median third of the scutellum. The wings are clouded on the costal region, the line of demarcation between the clouded and the more hyaline areas, however, indefinite; the venation is strong; r-m is usually present; m-cu is long; the three branches of the media extend almost to the posterior margin. The abdomen is typically ovate with the sides of the second to fourth segments approximately parallel; in one species, it is clavate.

Type, **Hoplitimyia (Stratiomyia) constans** (Loew), by original designation.

The seven known species may be separated by the following key.

Key of species

1. First antennal segment hardly three times the length of the second; abdomen clavate; discal cell small; cross-vein r-m wanting; the branches of the media comparatively weak ..... **clavata**

   First antennal segment five times the length of the second; abdomen ovate; discal cell of normal size; cross-vein r-m distinct; the branches of the media fairly strong 2

2. The second abdominal segment, except sometimes the lateral margins, entirely black 3

   The second abdominal segment with prominent yellow markings 4

3. The fourth and fifth abdominal segments in large part, usually half or more, yellow ..... **mutabilis**

   The fourth segment with a large crescentric yellow band; the abdomen otherwise, except the lateral margin, and sometimes a pair of small spots on the first segment, black ..... **semiluna**

4. Bands on the second segment very narrow, usually entire 5

   Bands on the second segment moderately broad, interruped 6

5. Body brown; fourth segment margined posteriorly with yellow ..... **vespoides**

   Body black; no yellow on the fourth segment ..... **subalba**

6. Scutellum yellow in both sexes; second segment with an interrupted yellow band ..... **constans**

   Scutellum of male black; second segment with two large yellow spots ..... **bimacula**

Subgenus Himantomyia James, nov.

Type, **Hoplitimyia (Himantomyia) clavata** James, n. sp.

The above species is distinct enough to warrant separate sub-generic consideration; yet its affinities to the typical species of **Hoplitimyia** are too close to permit

generic separation. The first antennal segment is scarcely three times as long as the second; this lower ratio is due, however, not to the shortening of the first, but to the elongation of the second segment, the length of which is twice as great as the maximum width. The occiput is but slightly concave. The wings are slightly narrower than in the typical subgenus, the clouded area being likewise narrower; the discal cell is small, the veins emerging from it, especially the first and third branches of the media, being weakened; cross-vein r-m is wanting. The abdomen is distinctly clavate and widest on the fourth segment.

Hoplitimyia (Himantomyia) clavata James, n. sp.

Male. Head black, marked with yellow as follows: a small triangle in front of and a small subcordate spot behind the ocellar triangle; the lower occipital orbits; a narrow stripe along each eye on the lower part of the face; the lower facial margins; the inner oral margins; and a band extending from the lower facial margin on each side, around the facial depression, to the middle of the outer oral margin. Pile of head brownish, rather thick, about half as long as the first antennal segment; some short black and yellow pile intermixed on the occiput; a tuft of moderately short black pile just anterior to the yellow triangle of the vertex. Eyes briefly contiguous below. Antennae brownish black; the first segment, however, yellow at base and gradually becoming brown. Thorax black, marked with yellow as follows: the humeri; a small spot on each side in front of the suture; the supra-alar regions and a small streak produced from each toward the suture; the broad sides and apex of the scutellum; a band extending from the dorso-pleural suture behind each humerus to the front coxa; a small spot on the upper part of each sternopleuron; a triangle on each mesopleuron in front of the wing base; and a narrow band extending from each wing base to the posterior coxa. Pile long, yellow; in addition, some short, black pile on the dorsum, especially posteriorly on the sides. Legs brownish black; the knees and basal third of each tibia, the basitarsi, and the second segment of the posterior tarsi, yellowish. Halteres blackish. Wings yellowish-hyaline, the clouded areas brown. Abdomen black; on the dorsum, the lateral margin and a small posterior

triangle on each side of the first segment and a more prominant posterior triangle on each side of the second segment are whitish, and the posterior margins of the third, fourth, and fifth segments are yellowish; on the venter, the second segment and the contiguous interrupted apical margin of the first segment are whitish, and the apical margins of the third, fourth, and fifth segments are yellowish. Length, 9.5 mm.

Holotype: male. Banos, Ecuador. Nov. 16, 1937. (S. W. Frost.)

Subgenus **Hoplitimyia** James

The six species which comprise the typical subgenus form a more or less variable complex of closely related species.

Hoplitimyia (Hoplitimyia) mutabilis (Fabricius)

Stratiomys mutabilis Fabricius, Ent. Syst., IV, 266, 1794.

This species was very aptly named, as is indicated by the great amount of variation which occurs within it. The black abdomen, with the apex yellow, will distinguish it from other species. The yellow apex may include the fifth segment, except for its anterior and posterior margins, and the apical half of the fourth segment, or these markings may be somewhat reduced. The scutellum is usually black in the male and yellow with a subapical transverse black band in the female, but it may vary to entirely yellow in both sexes. The femora are usually black, with the tibiae and tarsi paler, but variably colored. The abdomen is strongly inflated and, when seen in the right light, silvery pilose above and below, especially in the male, the silvery sheen appearing strongest ventrally.

This is a widely distributed species, and evidently occurs on the mainland throughout tropical America, from Mexico to Argentina. For the United States. I have records from Tucson, Ariz., Oct. 10, 1923; Pima County, Ariz., July 27, 1927 (R. H. Beamer); Donna, Texas, April 10 and Oct. 15, 1933 (J. W. Monk); and Harlington, Texas, April 24, 1931. I have no records of it from the West Indies.

Hoplitimyia (Hoplitimyia) semiluna James, n. sp.

Male. Black, rather copiously clothed with moderately long, white hairs. Head black; a small yellow spot adjacent to each eye on the lower part of the face, and another almost contiguous pair just above the oral margin in the middle; the very narrow lower occipital orbits, extending onto the checks, yellow. Antennae black; the first segment yellow at the base, gradually becoming black. Thorax black; the indefinitely defined apical half of the scutellum, the supra-alar calluses, a large triangle on each mesopleuron, and a smaller one just anterior to the wing base, the upper margins of the sternopleura, and obscure markings on the metapleura, yellow. Femora black; tibiae and tarsi yellowish brown, the apices of the front tibiae and the apical tarsal segments more blackish. Halteres yellow. Wings typical. Abdomen somewhat flattened, black; the very narrow lateral margins of all segments and a prominent crescentric spot on the posterior half of the fourth, yellow; the first ventral segment, the broad lateral margins and middle of the second, and the narrow posterior and lateral margins of the other segments yellow. Abdomen silvery pilose below, but not above. Length, 9.5 mm.

Female. The yellow markings on the head and thorax are much more prominent; the complete occipital, facial, and frontal orbits are yellow; the facial orbits are considerably broadened into a triangular projection inward below the vertex; the occiput is yellow just behind the vertex; there is a complete transverse yellow band above the antennae, and a pair of yellow spots, one to each side of the facial prominence, below the antennae. The first antennal segment is wholly yellow, and the oral margin is somewhat yellowish within. The yellow spots on the pleura are more expanded; on the notum, the humeri and a pair of spots just anterior to the suture and removed from the notopleural suture are yellow; the scutellum is entirely yellow. The second ventral segment is almost wholly black; the first has a black posterior margin.

Holotype, male, Mendoza, Argentina, Oldenburg Collection. In the collection of the Deutsche Entomologische Institut.

Allotype, female, same data.

Paratopotypes, 2 males, 1 female, same data.

This species is closely related to **mutabilis**; it may be distinguished by the lack of yellow markings on the fifth tergite, the lack of silvery pile on the abdominal tergites, and the less robust form. As in **mutabilis**, this species is evidently subject to considerable variation. The legs may be entirely yellowish, the scutellum in the male entirely yellow, and the markings of the thorax, venter, and head may vary in their extent.

Hoplitimyia (Hoplitimyia) vespoides (James)

Stratiomys vespoides James, Jour. Kans. Ent. Soc. 6:67, 1933.

This species is closely related to **sulbalba**, and is probably only a variety of that species. It is distinguished by the brown color, the presence of a complete yellow apex on the fourth segment dorsally, the short brown pile of the abdomen, the great reduction of the silvery ventral areas, and the extensive brown markings of the venter. The silvery pile of the venter is reduced to a large patch on the second segment; the venter is brown, except the first segment and the narrow lateral and posterior margins of the remaining segments. Length, 10 mm.

The type bears the label "Colo., July." No exact locality is given. Type in the Snow Entomological Collection, University of Kansas.

Hoplitimyia (Hoplitimyia) subalba (Walker)

Stratiomys subalba Walker, List, V, 41, 43, 1854.

Stratiomys gerstaeckeri Bellardi, Saggio, I, 31, 1859.

To judge from Walker's description, **Stratiomys subalba** can not be a synonym of **S. mutabilis** Fabricius, as Williston considered it. The synonymy given above is, I believe, correct. In **S. subalba**, the bands on the second and third abdominal segments are interrupted, whereas they are entire in **S. gerstaekeri**; these bands, however, consist of very narrow posterior margins, and may easily be variable. The abdominal pattern in this species will readily distinguish it from all others except **H. vespoides**. The venter, especially in the males, is densely silvery pilose, and predominantly yellow in ground color.

Type in the British Museum (Natural History). Distribution, Mexico to Brazil.

Hoplitimyia (Hoplitimyia) constans (Loew)

Stratiomyia constans Loew, Cent., X, 8, 1872.

A black species, handsomely marked with yellow; the thorax has three yellow spots or each side of the dorsum, the first including the humerus, the second just in front of the suture, and the third on the supra-alar callus; in the female, the first two spots on each side may be fused; the notopleural suture is broadly margined with yellow on the pleura, more extensively so in the female; the female usually has an additional spot on each sternopleuron and metapleuron. The head in the female is largely yellow; in the male, it is black with two pairs of yellow spots on the face. Scutellum wholly yellow. Abdomen black, with a pair of yellow spots on the second, third, and fourth segments; these spots are half the length of the segment at least on segment three; on segments three and four of the female, they fuse into a transverse band on the posterior half of each segment. Abdomen silvery above in the male, less so on the venter. Legs yellow. Length, 10 mm.

Type, from Texas, in the Museum of Comparative Zoology, Cambridge, Mass. I have numerous records from Kansas, Oklahoma, and Texas, June to September.

Hoplitimyia (Hoplitimyia) bimacula (Bellardi)

Stratiomys bimacula Bellardi, Saggio, App. 10, 1862.

A moderately large, black species, with a pair of small yellow spots on the face, and small spots on the humeri and supra-alar calluses. The abdomen has a pair of large, translucent yellow spots on the second segment; these occupy all the segment except the anterior and lateral margins, and the narrow longitudinal stripe which lies between them and separates them. Venter greenish yellow with silvery pile. Legs predominantly dark. Length, 11 mm.

The male type is from Mexico; the female is unknown. I have seen a series of males from Yucatan (G. F. Gaumer, in the Snow Entomological Collection); these agree perfectly with Bellardi's description.

III. The genus **Udamacantha** Enderlein

In 1914, Enderlein proposed the generic name **Udamacantha** for **Stratiomys inermis** Wiedemann, from Argentina. He gave the following generic characters: eyes bare, contiguous in the male for a considerable distance; scutellum very broad and short, somewhat flattened apically, and unspined; tibiae without apical spurs; antennae shorter than the head, the first segment two and one-half times, the second, twice, as long as broad; the flagellum cylindrical, five-segmented, the third antennal segment (the first of the flagellum) two and one-half times, the fourth and fifth each twice, as long as broad; the sixth and seventh together only two-thirds as long as the fifth, the apex rounded; cross-vein m-cu rather long; cross-vein r-m punctiform, or the discal cell lying on the radius; R^{2+3} distal of the cross-vein; R^4 wanting.

To the above generic characters, I should add that the antennae are situated on a definite rounded facial prominence; the proboscis, if straightened, would be almost as long as the height of the head; the labella are slender and rigid; and the three branches of the media are strong, of equal length, and reach almost to the wing margin. In the specimens which I have seen, the antennae are at least as long as the head, and cross-vein r-m is distinctly present, though sometimes very short. This last character seems to be quite variable in this genus and in the closely related **Labostigmina.**

Enderlein referred to **Udamacantha,** in addition to the genotype, **Odontomyia anodonta** Macquart, from South Africa, and **O. exul** Walker, locality unknown. If my identification of **anodonta** is correct, it is a true **Odontomyia,** the spines of which had been broken off, as often happens. Macquart's description otherwise applies perfectly to specimens which I have seen from Southern Rhodesia. I have not identified Walker's species, and it can not be placed on the basis of the description.

Brethes (Ann. Soc. Cient. Argentina, 93: 139, 1933) described **Udamacantha bonariensis** from Buenos Aires, but this species can not belong to this genus, as Brethes describes its ten-segmented antenna in detail.

The number of previously described species that can be referred to this genus is, therefore, only two, with the

possibility that **exul** is not a **Udamacantha**. **Exul** is described as a black species, with the "legs pitchy," the "feet tawny," and the "wings whitish." An additional species is described in this paper.

Udamacantha protrudens James, n. sp.

Female. Head yellow; ocellar triangle black; a large spot in front and to the side of the ocellar triangle, and a small oblique spot on each side of front, adjacent to the eyes, brownish, the color of each spot gradually merging into yellow. Front on upper part prominently raised above the vertex, thence gradually sloping to the facial prominence; facial prominence conspicuous, the antennae almost at its apex. Antennae bright yellow on the first and second segments, the remainder more brownish; the flagellum about half again as long as the two basal segments combined. Head almost bare; some short, scattered black pile on the front and vertex, and some scattered yellow pile of similar length on the face. Proboscis black, yellowish basally. Occiput and occipital orbits yellow. Thorax yellow; the dorsum with three broad black longitudinal vittae; the median one the broadest, and extending from the neck to the base of the scutellum, but tapering behind the suture and touching the scutellum only at a point; the lateral vittae but narrowly separated from the median one, almost attaining the base of the scutellum, where the yellow ground color becomes brownish, but broadly separated from the anterior margin of the dorsum; pectus reddish brown, briefly blackish in the middle. Scutellum wholly yellow. Pile scant, short, yellow. Legs yellow, the tarsi becoming brownish apically; wings hyaline; veins yellow. Abdomen yellow in ground color, but, in actuality, in large part a diffused brownish yellow; the clear yellow areas include all the venter and, on the tergites, the lateral margin, the sides of segment one, large lateral triangles on segments two, three, and four, which reach the base of segment two, and the apex of segment five; these areas are clothed with short, inconspicuous, black hairs which arise from blackened punctures; the abdominal pile is otherwise yellow and inconspicuous. Length, 8 mm.

Male. Vertical triangle and occiput black. Frontal triangle and upper part of face brown; face yellow on lower half; the facial prominence inconspicuous. Pile of front black, of face, yellow. Thorax black, with broad

yellow margins; black of pectus extending broadly onto the mesopleura: scutellum narrowly black at base; pile of thorax much longer than in the female. First abdominal segment black, broadly yellow at the sides; second and third yellow, with a narrow median stripe running from the anterior margin of the second to the posterior margin of the third, and with squarish black spots on the anterior corners of the third; fourth black, with the very narrow lateral margins and a small rectangular spot at each posterior corner yellow; fifth black; with the lateral and apical margins yellow; venter wholly yellow. Otherwise, except sexually, as in the female.

Holotype: female, Cordoba, Argentina (Davis) In the Museum of Comparative Zoology, Cambridge, Mass.

Allotopotype: male, same data.

Paratopotype: female, same data.

Also a male and female, same data, in a somewhat teneral condition.

Udamacantha inermis (Wiedemann)

Stratiomys inermis Wiedemann, Aus. Eur. Zwf. Ins., II, 71, 18, 1830.

The female, according to specimens from Mendoza, Argentina (Deutsche Entomologische Institut), differs from **protrudens** as follows. The vertex is largely black, the posterior margins and ocular orbits, however, being yellow; the front is marked by a black bar over the antennae and by three spots above, one touching each eye, and a geminate middle spot ,sometimes twice connected to the black of the vertex. The front is not so prominent above, nor is the facial prominence so conspicuous. The thoracic dorsum may be described as black, with broad yellow lateral margins and with a pair of median yellow vittae which may extend almost from the anterior margin almost to the base of the scutellum; the scutellum, as in **protrudens,** is wholly yellow. The abdomen is black, with broad yellow margins on segments two to five and a broad apical margin on five; segments two, three, and four each bear a pair of conspicuous yellow spots on the disc.

The extent of the markings on the head and thorax is subject to some variation. Wiedemann does not mention the median stripes on the thorax, though otherwise his description agrees with mine. The male, according to Wiedemann, has the yellow abdominal spots connected or almost so.

NEW AND LITTLE KNOWN PHYLLOPHAGA FROM TEXAS, (SCARABAEIDAE, COLEOPTERA)[1]

H. J. REINHARD, College Station, Texas.

Among the species of **Phyllophaga** described in this paper are included certain forms that are of considerable interest because of their economic importance. Names for these are required in investigations being conducted on their biology and control. Types of the new species described below are in the Texas Agricultural Experiment Station collection. Brief notes are included on several little known species previously described from the State.

I am under obligations to my colleagues who collected most of the new forms as indicated under the descriptions. To Dr. E. A. Chapin, Messrs. H. C. Fall and M. W. Sanderson acknowledgment is made for helpful assistance in comparing certain species with types in their charge or other material in their personal collections.

Phyllophaga rubricosa, n. sp.

(Plate 1)

Form variable in the sexes, reddish brown, surface above alutaceous and feebly shining. Clypeus concave, vaguely emarginate, moderately reflexed, coarsely, deeply punctured; suture subangulate. Front convex, punctures slightly coarser than on clypeus. Antennae with ten segments. Thorax obtusely angulate at middle, narrowed at base and apex, margin usually crenulate but sometimes nearly entire; punctures moderately coarse, not dense, irregularly spaced, each bearing a short decumbent hair. Mesosternum closely punctate, beset with sparse, short pale hairs. Prosternal process projecting downward at sides, prominent. Legs shining reddish brown; tooth of claw always well developed, acute, intramedian. Scutellum wider than long, with moderately coarse, deep punctures on apex and sides. Elytra more evenly, finely punctured than thorax, each puncture bearing a minute hair, not conspicuous; sutural costae feebly elevated but distinct, discal and submarginal costae almost entirely obliterated. Abdomen feebly shining, sides finely, not closely punctate, clothed with sparse, short

1 Contribution No. 495 from the Division of Entomology, Texas Agricultural Experiment Station, Agricultural and Mechanical College of Texas.

hairs. Pygidium wider than long, surface translucent, with scattered, vague punctures, apical margin cilate.

Length, 12-15 mm.; width, 6-8 mm.

Male.—Oblong, nearly parallel, body winged. Antennal club pale yellow, almost equal length of funicle. Abdomen slightly flattened at middle; fifth ventral segment simple; sixth segment very short, with a vague median transverse impression, hind margin entire, ciliate. Hind tibiae obliquely truncate; spurs moveable, slender, obtuse, inner subequal and outer three-fourths the length of first hind tarsal segment. Hind tarsi moderately stout, longer than tibiae.

Female.—Body ovate, ventricose, apterous. Antennal club distinctly shorter than funicle. Abdomen evenly convex at middle; fifth ventral segment slightly depressed on apical third and somewhat flattened at sides; sixth segment about half the length of preceding, hardly depressed at middle, apex entire. Hind tarsi distinctly shorter than tibiae. Tooth of claw longer and more nearly median than in male.

Holotype male and Allotype female, Dimmit County, Texas, March 13, 1938 (M. J. James). Paratypes: 224 males and 14 females, Dimmit and Zavala Counties, Texas, March-April, 1933-38 (S. E. Jones, M. J. Janes, T. B. Randolph); 1 male, Wharton, Texas, March 16, 1932 (S. E. McGregor); and 2 males Pleasanton, Texas, March 10, 1933 (C. E. Heard).

Related to **epigaea**, an almost wholly black species, which differs structurally in having shorter hind tibial spurs, prosternal process poorly developed, and tooth of claw small or obsolete in the male sex. There are also differences in sculpturation. It may be mentioned that **epigaea** has been collected most commonly during the day time, while **rubricosa** is generally inactive until shortly after dark. All males of the type series were taken either in light traps or under street lights in company with the females.

Phyllophaga renodis, n. sp.

(Plate 1)

Body apterous, ovate, convex, deep reddish brown with head and thorax darker, surface above alutaceous, feebly shining. Clypeus concave, nearly entire, moderately reflexed, coarsely, deeply punctate; suture sinuate. Front convex, surface closely, more coarsely punctured

than clypeus. Antennae with ten segments. Thorax convex with median area in front noticeably flattened, sides strongly angulate, base slightly narrower than apex, lateral margin crenulate; punctures coarse, not dense, irregularly spaced leaving smooth intervening areas on disc and near sides. Mesosternum rather coarsely, not closely punctate, sparsely clothed with short pale hairs. Legs shining brown, tarsi paler or reddish; tooth of claw strong, acute, intramedian, scutellum short, transverse, smooth or indistinctly punctured. Elytra strongly convex, humeral angles depressed and basal margin slightly reflexed; surface more finely and evenly punctate than thorax; sutural costae not very distinct, the discal and submarginal ones wholly obliterated. Abdomen somewhat shiny; sides with scattered but well impressed punctures and sparse pale hairs. Pygidium alutaceous, with coarse, shallow, sparsely placed punctures, apical margin reflexed, ciliate.

Length, 16 mm.; width 9 mm.

Male.—Antennal club shorter than funicle. Abdomen broadly flattened at middle; fifth ventral segment with a vague transverse ridge at middle; sixth segment short, with a shallow transverse median groove. apex entire, ciliate. Front tibiae tridentate, the tarsi with a small incurved tooth at inner apex of segments one to three. Hind tibial spurs free, slender, obtuse, inner about three-fourths and the outer three-fifths length of first hind tarsal segment. Hind tarsi rather stout, about as long as the tibiae.

Female.—Unknown.

Holotype: Fowlerton, Texas, March 23, 1938, taken while crawling on ground at midday by C. E. Heard.

The species resembles **cribrosa** in general appearance, but is readily distinguished by its smaller size, smoother, or non-costate elytra, red color, etc. There are also structural differences in the genitalia.

Phyllophaga plena, n. sp.

(Plate 1)

Form variable in the sexes, castaneous to piceous, glabrous above, subshining. Clypeus subconvex, broadly vaguely emarginate, moderately reflexed; punctures moderately coarse, dense, not deeply impressed; suture subangulate. Front convex, punctures close but slightly

coaser and deeper than on clypeus. Antennae with ten segments. Thorax widest at middle, apex narrower than base, sides crenulate, ciliate; surface rather finely punctate, the punctures moderately close on disc becoming much sparser at the sides. Legs reddish brown; fore tibiae tridentate, their tarsi with a tooth at inner apical extremity of segments one to four. Scutellum broader than long, with well impressed punctures at sides, median line usually smooth. Elytra rugulose, punctures fine, sparse and indistinct; sutural costae broad, well marked, the discal and submarginal costae scarcely visible. Abdomen moderately shining, rather sparsely, finely punctate, each puncture bearing a short hair, segments five and six more coarsely punctate with some longer hairs at sides. Pygidium moderately shining, rather finely, sparsely punctate, more convex and transverse in male.

Length, 19-24 mm.; width, 10-13 mm.

Male.—Form rather depressed, elongate, subparallel, castaneous, body winged. Antennal club yellow, equal or a trifle longer than stem. Mesosternum finely, closely punctate, clothed with dense, long, silky, yellowish hairs. Abdomen broadly impressed at middle; fifth ventral segment simple, surface finely scabrous beyond the narrow, polished basal margin; sixth segment about one-half the length of fifth, impressed at middle from base to apex, latter entire. Hind tibiae obliquely truncate; spurs moveable, long, broad, slightly curved, obtuse, outer about three-fourth as long as inner. Hind tarsi very distinctly longer than tibiae. Tooth of claw moderately long, intramedian.

Female.—Body robust, convex, ovate, dilated behind, piceous; elytra more or less fused along sutural margin, wings about normal in size but apparently nonfunctional. Antennal club reddish yellow, shorter than funicle. Mesosternum more coarsely punctate than in male, clothed with sparse, short, decumbent, pale hairs. Abdomen vaguely flattened at middle; apical ventral segment convex, coarsely, deeply punctured, shorter than preceding segment, hind margin entire. Legs stout, hind tarsi subequal the length of tibiae. Tooth of claw longer and more acute than in male.

Holotype male and Allotype female, San Patricio County, Texas, March 11, 1938 (T. M. Carson). Paratypes: 81 males and 319 females, same data as type; 4 males, and 1 female, Odem, Texas, February 18, 1938 (H.

Mecom); 14 males and 14 females, Nueces County, Texas, March 29-31, 1938 (C. E. Marcum).

The species is perhaps nearest **farcta** in relationship but may be distinguished at once by the non-gibbous pygidium, genital characters, coloration, and longer antennal club in male. There are additional minor differences.

Phyllophaga hamata Horn

(Plate 1)

Lachnosterna hamata Horn, Trans. Am. Ent. Soc., Vol. 14, 1887, p. 220.

Described from a unique male specimen from Texas, without precise locality. Several male specimens taken at San Angelo, Texas, June 14, 1932, by S. E. Jones check closely with the original description. Additional material includes: one male, Menard, Texas, June 10, 1932 (H. E. Parish); and two females, Sonora, Texas, June 3, 1938 (C. E. Heard).

The species is less robust in build than **torta**, to which it appears closely related. The genitalic characters in the female sex of the two species are quite similar, but the males are at once distinguished by wide differences in the structure of the genital claspers.

Phyllophaga ephilida virilis, n. subsp.

(Plate 1)

Similar to the typical form but readily distinguished in the male sex by the genital characters as illustrated.

Body slightly elongate, subcylindrical, moderately shining, rufocastaneous. Clypeus broadly reflexed, feebly emarginate, rather finely, closely punctured; suture strongly sinuate. Front subconvex, punctures denser, slightly coarser than on clypeus. Antennae with ten segments. Thorax widest at middle, sides arcuate, entire, punctures hardly coarser but distinctly sparser than on front. Mesosternum evenly punctate, sparsely clothed with rather short pale hairs. Tooth of claw strong, acute, intramedian. Elytra finely, not closely punctate; discal costae narrow, feeble, the sutural well defined. Abdomen shiny, sides sparsely, finely punctate, venter smoother. Pygidium moderately transverse, surface uneven, with large, vague punctures becoming more apparent near the sides.

Length, 15-17 mm.; width, 7-8 mm.

Male.—Antennal club shorter than stem. Abdomen somewhat flattened at middle; fifth ventral segment with a roughened semicircular depression on apical half, hind edge broadly, not deeply emarginate; sixth segment deeply impressed and roughened at middle, apex broadly, deeply emarginate. Hind tibia obliquely truncate; inner spur moderately long, lanceolate, subacute; outer spur fixed, obtuse, hardly one-third length of inner.

Female.—Specimens taken in company, but none in coitu, with the above described males, show no tangible characters to distinguish them from typical **ephilida** females.

Holotype male, Dickinson, Texas, June 30, 1931 (J. N. Roney). Paratypes: 4 males, same data as type, and 1 male, Dickinson, Texas, May, 1929 (F. M. Hull).

Phyllophaga sacoma, n. sp.

(Plate 1)

Oblong, slightly widened behind, reddish brown, surface pruinose. Clypeus concave, feebly emarginate, moderately reflexed; punctures moderately coarse, well impressed, not very close; suture sinuous. Front somewhat flattened, surface a little more coarsely punctured than clypeus. Antennae with ten segments. Thorax irregularly convex, widest slightly before middle, sides arcuate, margin entire except near basal angles; surface with moderate punctures, rather sparsely and irregularly placed, median line usually impunctate. Mesosternum pruinose, finely, densely punctured, thickly clothed with longish, silky, yellow hairs. Legs reddish, shining; tooth of claws strong, acute, median. Elytra more finely punctate than thorax, the punctures not dense and each bearing a very minute, pale, decumbent hair; sutural costae broad and distinct, discal and submarginal costae slightly elevated and visible to posthumeral region. Pygidium transverse, puncturation moderately dense at base, apex smoother, shiny, lateral and basal margins pruinose. Abdomen finely, sparsely punctate, beset with short, pale hairs, surface pruinose except on venter.

Length, 15-17 mm.; width, 7.5-9 mm.

Male.—Antennal club shorter than stem. Abdomen broadly flattened at middle; fifth ventral segment with a feeble arcuate ridge near middle; sixth segment irregularly concave, with apical margin broadly emarginate.

Hind tibiae obliquely truncate; inner spur long, lanceolate, slightly curved, obtuse; outer spur fixed, narrower, about half the length of inner. Hind tarsi slightly exceeding the length of tibiae.

Female.—Antennal club shorter than funicle. Abdomen vaguely flattened at middle; fifth ventral segment slightly depressed before hind margin, flattened and pruinose at sides, bearing a few long, erect, fine hairs; sixth segment feebly concave at middle, with narrow basal margin at sides slightly elevated, apical margin rather deeply and broadly emarginate. Hind tarsi hardly as long as tibiae. Hind tibial spurs broader and more obtuse than in male.

Holotype male and Allotype female, Smith County, Texas, April 30, 1937, (H. J. Reinhard and W. L. Owen, Jr.). Paratypes: 45 males and 5 females, same data as types; 20 males, Smith County, Texas, March-May, 1937 (W. L. Owen, Jr.); 2 males, Hearne, Texas, April 4, 1929 (F. F. Bibby); 1 male, Arp, Texas, April 27, 1917, without collector's label; 5 males, Prescott, Arkansas, May 4, 1932 (Mrs. S. E. McGregor). In the U. S. National Museum, 17 males from New Waverly, Texas, April 4, 1935 (W. H. Kellogg), and 1 male, Conroe, Texas, April 19, 1936 (H. A. Budde).

Without reference to the genitalia the present species might easily be confused with **micans.** There are seemingly no other important structural differences. The ground color of **sacoma** is apparently paler or more reddish than in typical **micans** or in **micans cupuliformis.**

Phyllophaga scitula Horn.

(Plate 2)

Lachnosterna scitula Horn, Trans. Am. Ent. Soc., Vol. 14, 1887, p. 256.

This fine species was also described from Texas without mention of any specific type locality. With the lapse of a half century no additional material appears to have been mentioned in literature. Three specimens taken by me at Bryan, Texas, April 16 and 23, 1934, trace readily to the present species in Horn's keys (loc. cit.). No additional material was accumulated until the species was discovered as not uncommon in Smith County, Texas, during April, 1937. Collections at that

time indicate that pecan is one of the preferred food plants.

The peculiar coloration and distinctive thoracic sculpturing make the species readily recognizable. It is also distinguished from allied forms by the genitalia. The latter show slight variations in structure in the male sex; the average condition appearing about as illustrated (Plate 2).

Phyllophaga curialis, n. sp.

(Plate 2)

Form oblong, oval, wider behind, dark brown to piceous, apparently glabrous above, surface moderately shining. Clypeus flattened, rather deeply emarginate, narrowly reflexed; punctures moderately coarse, dense, well impressed; suture feebly sinuate. Front subconvex, punctures closely placed as on clypeus but a little coarser. Antennae with ten segments. Thorax widest at middle, sides obtusely angulate, slightly narrowed to base and more obliquely covergent in front, margin entire; punctures setiferous, distinctly coarser than on front, rather sparse and irregularly spaced, setae of punctures near lateral margin longer but decumbent as on disc. Mesosternum densely punctate, hairs yellow, moderately long and dense. Legs shining red; tooth of claw stout, long, acute, median. Elytra rugulose, finely not closely punctate; sutural costae well marked, first discal broad behind gradually narrowed anteriorly and obsolete before base, submarginal costae narrow, not defined on basal half. Pygidium convex, transverse, rather finely, sparsely punctate, apical margin ciliate. Abdomen feebly shining, sides sparsely, finely punctate, clothed with short, pale hairs, last two segments more coarsely punctate.

Length, 19 mm.; width, 10 mm.

Male.—Antennal club shorter than stem. Abdomen broadly flattened and slightly concave at middle; fifth ventral segment with a feebly elevated arcuate ridge, not reaching hind margin at sides; sixth segment rather deeply concave at middle from base to apex; latter abruptly, not deeply emarginate. Hind tibiae obliquely truncate; inner spur long, lanceolate, obtuse; outer spur fixed, rather broad, slightly twisted and decurved, about two-thirds length of inner.

Female.—Unknown.

Holotype: Liberty, Texas, April 6, 1934 (S. E. McGregor).

Allied to **profunda** but readily distinguished by the less robust build; finer, sparser thoracic puncturation; and in the structure of the male genital claspers.

Phyllophaga pudorosa, n. sp.

(Plate 2)

Body elongate, subparallel, castaneous to piceous, head and thorax more shining, surface of latter and elytra with sparse vestiture of both long and short pale hairs. Clypeus flat, deeply emarginate, narrowly reflexed; punctures dense, moderately coarse, well impressed; suture slightly sinuate. Front subconvex , punctures closely spaced, somewhat coarser than on clypeus. Antennae with ten segments. Thorax short, widest at middle, sides arcuate, slightly narrowed to base, more obliquely in front, margin entire; punctures as on front but but much sparser and irregularly placed, hairs near lateral margin considerably longer but decumbent. Mesosternum closely punctate, hairs pale yellow, moderately long not very dense. Legs wholly reddish; tooth of claw long, acute, median. Elytra rugulose, subopaque, sparsely beset with longish suberect and shorter decumbent hairs, punctures finer than on thorax, not deeply impressed and rather indistinct; sutural costae strong, considerably narrowed before anterior extremity, first discal and submarginal costae but slightly elevated and vaguely defined. Pygidium transverse, subshining, sparsely to moderately punctate, apical margin ciliate. Abdomen feebly shiny, sides finely, not densely punctate, each puncture bearing a short hair, segments five and six more coarsely punctate.

Length, 17-18 mm.; width, 7.5-9 mm.

Male.—Antennal club slightly shorter than stem. Abdomen flattened at middle; fifth ventral segment with a feebly elevated roughened arcuate ridge, sometimes barely defined; sixth segment rather broadly depressed at middle, apex abruptly, not deeply emarginate. Hind tibiae obliquely truncate; outer spur fixed, moderately wide, subacute; inner spur lanceolate, slightly curved, obtuse, nearly twice as long as outer.

Female.—Unknown.

Holotype male, Daingerfield, Texas, June 24, 1937, State Park Survey. Paratypes: 1 male, same data as type; 2 males, Shreveport, Louisiana, May 18 and 25, 1937, (W. C. Pierce), in the U. S. National Museum.

The species traces to **hirticula** and **delata** in Horn's keys, but differs from both in the structure of the male genital claspers. In the present species the thoracic punctures are much finer than in **hirticula,** and the hairs on the elytra are noticeably sparser and longer than in **delata.**

Phyllophaga opacita, n. sp.

(Plate 2)

Body oblong, subcylindrical, ferrugineous head sometimes slightly infuscated, surface subopaque, uniformly clothed with fine, short, depressed, pale hairs. Clypeus subshining, shallowly emarginate, narrowly reflexed, punctures moderately coarse, closely spaced, well impressed; suture sinuous. Front convex, more finely and densely punctured than clypeus. Antennae composed of ten segments. Thorax above rather evenly convex but with a vague depression at middle near either side, latter arcuate, margin entire; punctures very fine, feebly impressed, closely, evenly spaced, with each bearing a short hair. Mesosternum moderately, finely punctate, hairs rather short, not dense. Legs reddish; front tibiae tridentate; tooth of claws long, acute, median. Elytra with punctures as on thorax; sutural costae strong, first discal costae barely elevated, poorly defined, submarginal costae narrow but distinct. Abdomen more shiny than above, finely, not closely punctured, clothed with short depressed hairs with some longer and erect on last two segments. Pygidium finely punctate, subshining, clothed with short hairs.

Length, 14.5-16 mm.; width, 6-7.5 mm.

Male.—Antennal club yellow, slightly shorter than stem. Abdomen not noticeably flattened at middle; fifth ventral segment with a submedian, transverse, granular carina, broadly divided at middle and declivous posteriorly; sixth segment about half as long as preceding, flattened or vaguely impressed at middle, apex entire. Hind tibia about equal the combined length of its four proximal tarsal segment; spurs moveable, slender, acute, slightly decurved, inner one a trifle longer than outer.

Female.—Antennae wholly reddish, club shorter than funicle. Abdomen evenly convex at middle; fifth

ventral segment simple, plane in profile gradually sloping to hind margin; sixth segment flat or almost so at middle, more coarsely punctate than fifth and only about one-half as long, apex entire. Hind tarsi about equal the length of tibiae. Hind tibial spurs obtuse and much broader than in male.

Holotype male and Allotype female, Bastrop, Texas, July 15, 1937, State Park Survey. Paratypes: 1 male, same data as type; and 4 females, from same locality, July 27-31, 1937.

The present species checks closely with Horn's description of **arcta** (Trans. Am. Ent. Soc., Vol. 14, pp. 271-2). The original type series of **arcta** (not seen by me) included two female specimens from some unknown locality in Texas. In the presence of a second closely related form it might seem impossible to decide which one is to be taken as the true **arcta.** It may provisionally be assumed that the common East Texas form will prove identical with **arcta** and its counterpart, a much less common form from Southwest Texas, represents a new species as described above. The two species differ most essentially in genital characters as illustrated (Plate 2).

Phyllophaga tristis (Fabricius)

Melolontha tristis Fabricius, Species Ins., 1, 1781, p. 39.

Texas specimens which trace to the present species in all available keys show variations not only in sculpture, size, and coloration, but also in some of the secondary sexual characters commonly employed to distinguish forms of specific rank. The male genital claspers are practically the same throughout the series, but there are seemingly important differences in the structure or shape of the apical process of the internal genital sac that may be used to distinguish restricted forms within this complex.

Tristis was originally described in 1781 from "Boreal America." The type specimens probably came from the northeastern section of the United States, and it may be assumed that the common form of that region agrees most closely with the type series. Accordingly, this common northeastern form considered as **tristis tristis,** without examination of the type, may be characterized as follows:

Body oblong, slightly widened behind, testaceous, with sparse vestiture of pale hairs, latter long and erect on head and thorax, shorter and suberect on elytra.

Clypeus concave, entire, moderately coarsely, not densely punctate. Front convex, coarsely, closely punctate. Antennae with ten segments. Thorax moderately shining, coarsely, rather closely punctate, sides angulate, margin entire except sometimes near base, anterior angles distinct but not produced. Mesosternum densely, finely punctured, hairs thick, long, pale yellow. Legs reddish, shining; hind tarsus about equal length of tibia. Elytra moderately shiny, punctures well impressed, finer than on thorax but not dense; submarginal and discal costae not defined, sutural feebly elevated but distinct. Pygidium vertical, transverse, subshining; rather coarsely closely punctate, clothed with intermixed short and longish hairs, latter erect. Abdomen moderately shining, sides rather finely, sparsely punctate, hairs short, extending on venter.

Length, 12-14 mm.; width, 6-7.5 mm.

Male.—Antennal club subequal length of stem. Abdomen flattened at middle; fifth ventral segment with a short, transverse, almost acute ridge near anterior margin, impressed and roughened at middle, hind margin abruptly emarginate; sixth segment transversely elevated on narrow basal margin, apex entire. Internal genital sac with the apical process moderately protruding, subulate, only slightly bowed as viewed from side. Spurs of hind tibiae moveable, slender, obtuse, inner one longer than first hind tarsal segment. Tooth of claws rather small, acute, intramedian.

Female.—Antennal club slightly shorter than funicle. Abdomen vaguely impressed at middle; apical segment convex, apex entire. Tooth of claw longer and more nearly median than in male.

This form extends from the Northeast Atlantic seaboard westward to British Columbia and southward to Georgia. It is not represented in the present available Texas material.

Phyllophaga tristis apicata, n. subsp.

Similar to typical form except as follows: Size smaller, rufotestaceous, surface more shining in both sexes. Male antennal club usually distinctly shorter than stem. Abdomen rather broadly flattened at middle; fifth ventral segment with a feebly elevated, transverse, roughened ridge at middle near front border. Internal genital sac bearing a rather short, thick apical process, narrowed

outwardly in profile to a slightly emarginate apex with the anterior extremity angularly produced as a short, acute tooth.

Length, 10-12 mm.; width 5-6 mm.

Holotype male and Allotype female, College Station, Texas, April 30, 1930 (H. J. Reinhard). Paratypes: Five males and 10 females, same data as type; 2 males and 1 female, Smith County, Texas, April 21 and 30, 1937 (W. L. Owen, Jr.); 1 female, Atlanta, Texas, April 25, 1925, without collector's label; 4 males and 2 females, Tonganoxie, Kansas, State Lake, April 29, 1933 (M. W. Sanderson); 2 males, Cody's Gap, Arkansas, April (Archer); 1 male, Mobile, Alabama, March 15, 1913 (H. P. Loding); 1 male labeled "Auburn, Alabama"; 3 males and 2 females, Zebulon, Perry and Rome, Georgia, April 1937-38, all collected by P. W. Fattig; 9 males and 1 female, Walhalla, Chappells and Florence, South Carolina, February 19, 1931, and March 17, 1929 (O. L. Cartwright) and April 20, 1937 (J. G. Watts). 1 male, Paducah, Kentucky, May 6, 1937 (Paul Ritcher); 1 male, Washington, D. C., April 23, (H. S. Barber); and 1 male, Takoma Park, Maryland, April 29, 1933, without collector's label.

Phyllophaga tristis suttonana, n. subsp.

With the essential characters of **tristis tristis,** except: Rufotestaceous in color, surface more shining in both sexes. Front more coarsely, cribrately punctured; anterior thoracic angles acute, somewhat produced; ventral carina of abdomen in male a little more prominent than in preceding form. Apical process of internal genital sac elongate, somewhat flattened beyond basal curvature, but narrow and gradually tapering toward tip, which bears a pale semitransparent membrane. Hind tibial spurs moderately broad, inner one subequal the length of first hind tarsal segment.

Length,12-14 mm.; width, 6-7 mm.

Holotype male and Allotype female, Sonora, Texas, April 14, 1932 (S. E. Jones). Paratypes: Four males and 6 females, same data as type; and 2 males, San Angelo, Texas, April 5, 1932 (S. E. Jones).

Phyllophaga tristis amplicornis, n. subsp.

Similar to **tristis tristis** in all respects except: Less robust in build, elytra flavotestaceous, head and thorax

more finely punctate, eyes distinctly larger and more prominent. Male antennal club equal or longer than stem, usually somewhat bowed near apex. Fifth ventral segment of abdomen with a long thin or blade-like transverse ridge near anterior margin, flattened or vaguely impressed at middle, hind edge deeply emarginate; sixth segment short, transversely impressed at middle, apex slightly notched. Apical process of internal genital sac strickingly flattened on distal part, lanceolate to spatulate in outline as viewed from behind, the margin pale and semitransparent. Tooth of claw in female intramedian as in male.

Length, 10.5-14 mm.; width, 5-7 mm.

Holotype male and Allotype female, Stephenville, Texas, April 28, 1937 (N. Randolph). Paratypes: Sixty-four males and 28 females, Stephenville, Texas, March 25 to May 7, 1938-39 (N. Randolph); 6 males and 1 female, Smith County, Texas, April-May 1937-38 (W. L. Owen, Jr., and H. J. Reinhard); 4 males, Bexar County, Texas, March-April, 1929 (H. B. Parks); 1 male and 1 female, Pleasanton, Texas, February, 1934, and March, 1938 (C. E. Heard); 2 females, Cameron, Texas, April 28, 1938 (M. J. Janes). In the University of Kansas Collection, 2 males, Colorado County, Texas, April 7, 1922, "U. of K. Lot 1116"; and in the Field Museum of Natural History Collection, 2 females labeled "Texas" without date or collector's label.

Phyllophaga tusa Horn

(Plate 2)

Lachnosterna tusa Horn, Trans. Am. Ent. Soc., Vol. 14, 1887, pp. 290-291.

This interesting little species was originally characterized from nine male specimens collected near San Antonio, Texas, by F. S. Aaron. Although the species does not appear uncommon, no other mention of it seems to have been made in literature. A total of 82 male specimens were taken by S. E. Jones and M. J. Janes at Winter Haven, Texas, in light trap collections extending from April to July. The female sex is not known.

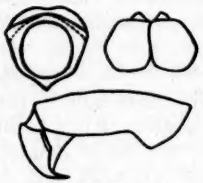
The bidentate anterior tibiae, long antennal club, peculiar ventral carina, and genitalia in the male are distinctive characters, which at once distinguish the species from all related known forms in Texas. It may be point-

ed out that the piceous thoracic spot mentioned by Horn is frequently absent, and in such cases the pale coloration of the upper surface contrasts sharply with the wholly black head. No food plants have been recorded for the species.

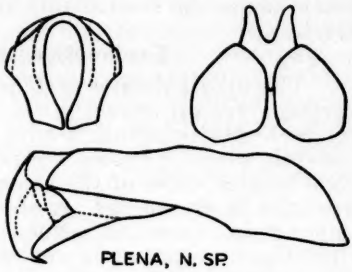
Explanation of Plates

The diagrammatic sketches of the male and female genitalia are all drawn to the same scale. Illustrations for each species include a hind view of the male claspers, beneath which is shown a right lateral view or left and right lateral views of the same. Sketches of the female genitalia in six species are shown in ventral view at the upper right, except in **scitula,** where the upper left and right figures represent a ventral and a right lateral view, respectively.

Plate I



RUBRICOSA, N. SP.

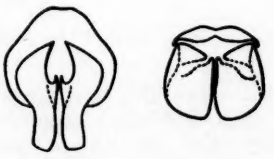


PLENA, N. SP.

RENODIS, N. SP.

HAMATA HORN

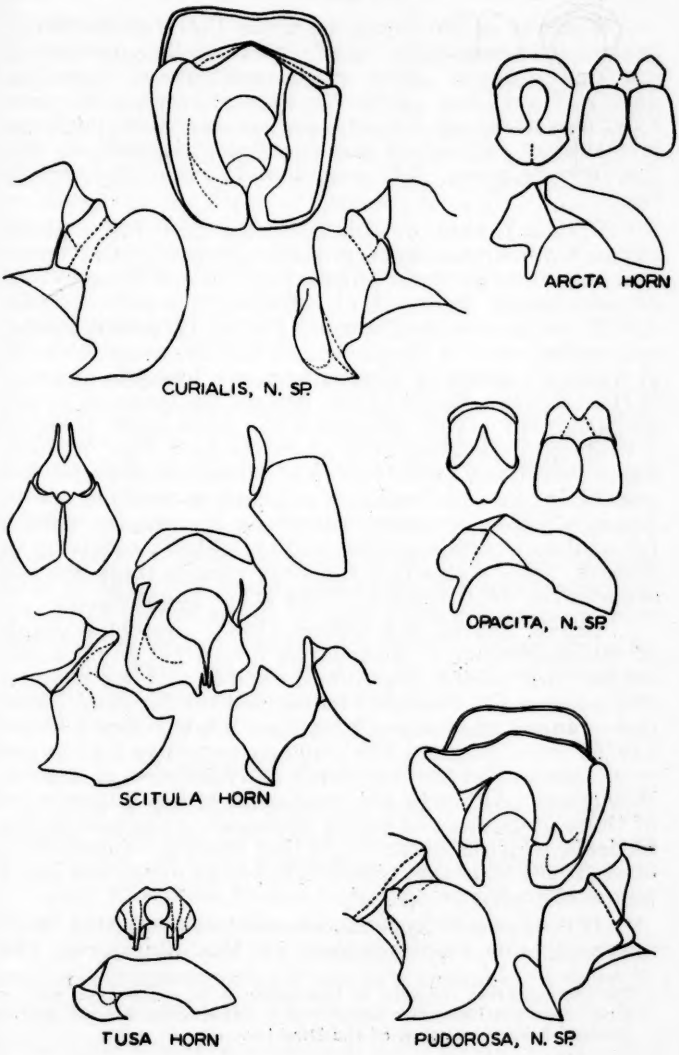
EPHILIDA VIRILIS, N. SUBSP.



SACOMA, N. SP.

EPHILIDA SAY

Plate II


ARCTA HORN
CURIALIS, N. SP.
OPACITA, N. SP.
SCITULA HORN
TUSA HORN
PUDOROSA, N. SP.

OBSERVATION ON WHITE GRUB PUPATION *

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A survey of the North American literature on white grubs (Phyllophaga) shows that workers in several states and Canada have made statements regarding depths of pupation. However, in most cases, even when a definite statement is made, the species of Phyllophaga involved are not named and no attempt is made to distinguish between the pupation habits of the various species.

Forbes (1891) of Illinois states that white grubs pupate a few inches underground. Forbes (1907) infers that Phyllophaga grubs pupate from two or three to five or six inches below the surface of the soil. Criddle (1918) states that four species, **Ph. anxia, drakii, nitida,** and **rugosa** occur in Manitoba and that the average depth at which all stages of Phyllophaga are found in summer is four inches. Davis (1918, revised by Davis in 1929) and Luginbill (1938) present a life cycle chart showing a white grub pupating at or above the plow line. According to Sweetman (927) larvae of Minnesota May beetles pupate in the soil from a few inches to two feet deep. Hayes (1928) presents records on hibernation depths for adults of certain species of Phyllophaga occurring in Kansas and states that for some species these are the same as the depths at which the grubs pupated.

Drake, Travis, and Collins (1933) present a graph of the distribution of hibernating adults (in pupal cells) for 169 May beetles dug from the soil in an Iowa pasture. The mean depth was 11.47 inches and the depth of pupation ranged from 3 to 17 inches. Ritcher and Fluke (1935) state that 213 Phyllophaga prepupae and pupae were found at an average depth of 16.2 inches at Argyle, Wisconsin. Although not mentioned in this paper, most of these prepupae and pupae belonged to the species **Ph. hirticula** which is dominant in that vicinity. Chamberlin et al (1938) state that most Phyllophaga pupae are found below 10 inches in the soil.

It is apparent from the above statements that there is considerable contradiction in the literature. The

* The investigation reported in this paper is in connection with a project of the Kentucky Agricultural Experiment Station and is published by permission of the Director.

writer believes that the contradiction arises from three sources. In the first place, the larvae of some species of Phyllophaga pupate deep in the soil while others do not, even when present in the same soil. Since over 125 species of Phyllophaga occur in the United States and since the species of importance in any given area are often entirely different from those of other areas, writers making general statements concerning pupation often based their conclusions on different species complexes. In the second place, the depth of pupation for a given species of Phyllophaga may differ in different types of soil. Grubs do not go as deep to pupate in heavy clay as they do in silt loam soils. Drainage and soil moisture are also factors influencing pupation. In the third place, without doubt, some workers did not examine the soil to a sufficient depth.

Data on the pupation depths of several species of Phyllophaga was gathered in eastern Kentucky in 1936, 1938, and 1939. (Tables 1 and 2). Every record given is for a definite species of Phyllophaga in a definite soil type and each record was substantiated either by the finding of a prepupa or pupa which was reared to the adult stage or by locating the larval and pupal exuviae after an adult was found. Although the writer observed that Phyllophaga adults in most cases hibernate in their pupal cells, he has omitted all records where only the adult was found. Except in Area C, which will be mentioned later, every digging was made to the depth of at least 24 inches if soil conditions permitted.

Description of Areas Sampled[1]

Area A was fallow ground with a cover of annual grasses, ragweed, and smartweed. The soil type was Hagerstown silt loam which is one of the fertile soils of the Inner Bluegrass Region and similar to the Maury silt loams in structure. The area sampled was about halfway up an east slope in rolling country two miles southwest of Lexington. Area B was in a permanent bluegrass pasture. The soil type was Maury silt loam which is the

1. The writer is indebted to Martin E. Weeks for the identification of soil types.

TABLE 1. Pupation depths of **Phyllophaga hirticula, inversa, bipartita,** and **futilis** in several Kentucky soils.

No.	Place	Ph. hirticula				Ph. inversa				Ph. bipartita				Ph. futilis			
		No.	Min.	Max.	Mean	No.	Min.	Max.	Mean	No.	Min.	Max.	Mean	No.	Min.	Max.	Mean
A	Lexington	118	7.5in.	23in.	15.6in.	5	5in.	8in	6.6in.	1	7in.	7in.	7in.	9	7.5in.	17in.	12.4in.
B	Lexington	44	7in.	18.5in.	13.3in.	4	5.5in	8.5in.	6.9in.								
BA	Lexington	3	9in.	11in.	10in.									2	4in.	8in.	6in.
C	Lexington	2	9in.	15.5in.	12.2in.	1	5in.	5in.	5in.					42	4in.	11in.	7in.
D	Minorsville	2	10in.	17.5in.	13.8in.	20	3in.	7.5in	4.7in.	47	3in.	12.5in	8in.				

TABLE 2. Depths of pupation of **Phyllophaga fusca, fraterna, tristis,** and **kentuckiana** in several Kentucky soils.

No.	Place	Ph. fusca				Ph. fraterna				Ph. tristis				Ph. kentuckiana			
		No.	Min.	Max.	Mean	No.	Min.	Max.	Mean	No.	Min.	Max.	Mean	No.	Min.	Max	Mean
A	Lexington	5	7.5in.	9.5in.	8.4in					2	8in.	13.5in.	10.8in.				
B	Lexington	1	9in.	9in.	9in.									1	9in.	9in.	9in.
C	Lexington	3	4in.	9in	7in.												
D	Minorsville					6	4in.	17in	10.2in.	2	5in.	5.5in.	5.3in				

most important and fertile soil of the Inner Bluegrass Region. The area sampled was a high, well drained bottom land located five miles northeast of Lexington. Area BA was in sod and adjoined Area B. It was a very shallow phase of Maury silt loam located on a steep west slope.

Area C was a bluegrass pasture located on the Experiment Station Farm at Lexington. The soil type was Maury silt loam. The grub infestation was confined mainly to the higher part of a south to southeast slope. Area D was woodland, wild grass pasture located near Minorsville in Scott county, in the hill region that surrounds the Inner Bluegrass Region. Much of this area is poorly drained. Certain samples were dug in Eden clay while others were dug in heavy silt loam underlaid by Eden clay. Most of the beetles were obtained from the lower parts of the hill sides. Few were found on the higher, more rugged slopes.

Discussion

Ph. hirticula. This species is the dominant May beetle in the Inner Bluegrass Region of Kentucky and constitutes over 88 per cent of the population (Table 3). **Ph. hirticula** larvae, regardless of soil type, almost always pupate at least several inches below the plow line, if the plow line is assumed to be six inches (Table 1). Grubs of this species pupate at approximately the same depths in the fertile bluegrass pastures of eastern Kentucky as they do in the permanent bluegrass pastures of southern Wisconsin.

Ph. inversa. Slightly less than four per cent of the May beetles found in the Inner Bluegrass Region belong to this species. Larvae of **Ph. inversa** pupate at shallow depths even in the same samples where grubs of **Ph. hirticula** were found pupating deep in the soil. In heavy soils, **Ph. inversa** usually pupates above the plow line.

Ph. futilis. Most of the pupation records for this species were secured in Area C where this usually unimportant species was quite abundant. According to the records, half of the **Ph. futilis** larvae in this field pupated above the plow line. The data for Area C, however, does not give a true picture since the writer found later that he did not examine the soil to a sufficient depth. Many empty pupal cells and old exuviae were observed two years later at depths greater than the maximum given in the table.

Many of these were thought to be of **Ph. hirticula** which was present in greater numbers on this farm than the diggings showed. In Area A, where nine pupation records of **Ph. futilis** were secured, no evidence of this species pupating above the plow line was found.

Ph. fusca. A few records were secured for this uncommon species in three areas. Although the species pupated at rather shallow depths, only one individual was found above the plow line.

Ph. bipartita. Grubs of this species are very scarce in the Inner Bluegrass Region but are abundant in certain areas of the Intermediate Bluegrass Region and of Western Kentucky. Larvae of **Ph. bipartita** usually pupated deeper in the soil than did larvae of **Ph. inversa,** even in the same samples. Only four out of 47 individuals of **Ph. bipartita** were found pupating at or above the plow line.

TABLE 3. May beetles collected in 1936 in Fayette County, Kentucky.

Species	No. of beetles collected	Per cent of total
Ph. hirticula	9,759	88.2
Ph. inversa	407	3.7
Ph. futilis	340	3.1
Ph. hornii	224	2.0
Ph. tristis	201	1.8
Ph. fusca	67	0.6
Ph. rugosa	42	0.4
Ph. kentuckiana	8	0.1
Ph. bipartita	5	0.1
TOTAL	11,053	100

Other species. A few records for **Ph. fraterna, tristis,** and **kentuckiana** were obtained but the data is too meager to permit any conclusions.

Summary

Few definite statements are found in the liturature concerning the depths at which the various species of Phyllophaga pupate. Data on the pupation depths of

320 white grubs belonging to eight species of Kentucky May beetles is presented. It was found that **Ph. hirticula** larvae usually pupate deep in the soil while larvae of **Ph. inversa** pupate at shallow depths. **Ph. futilis, fusca,** and **bipartita** usually seek intermediate depths for pupation. Certain factors such as soil structure, soil drainage, and soil moisture may affect the pupation levels but they do not appear to change the relative positions of the various species. Differences in latitude appear to make little difference in the depth of pupation for a given species, other factors being equal.

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HABITS OF AEDES THIBAULTI DYAR AND KNAB.[1] (DIPTERA, CULICIDAE)

WILLIAM R. HORSFALL, Fayetteville, Arkansas

Aedes thibaulti is a mosquito of local importance which has been reported from Georgia, Alabama, Mississippi, Louisiana, Arkansas, and Missouri (1), (2), (4), (5). It is strictly a woodland species which is further localized because of the small number of suitable breeding places and by the short flight range of the adults. Nevertheless, it is a pest mosquito with which one has to contend when he is within the flight range.

This mosquito is a tree-hole species which requires a specific type of hole in which to breed. In Arkansas, larvae were found in only two of 41 holes in trees and stumps of varying sorts and in varying conditions under observation during 1935 and 1936. These were large cavities in the bases of sweet gum trees with openings so near the ground level that they were subject to flooding whenever the adjacent, intermittent stream reached flood stage. No larvae were ever collected from similar cavities in stumps or oak trees or from small holes in gum trees above the over-flow level. In Alabama, Shields and Lackey (4), collected larvae from similar holes in tupelo gum trees which stood in a semi-permanent pool.

Another reason why this mosquito is not widely spread over its range is that under ordinary conditions the adults will not fly far from their breeding places. No adults were collected over 50 feet from the water course along which they developed, although they ranged up and down the stream for greater distances.

The adults are not usually listed among the vicious species because they are not frequently encountered. Nevertheless, the bites are painful and the wheals often remain a day or more. The females attack readily when one passes near or disturbs the bushes or moss in the vicinity of the breeding places. However, those found resting within the cavities from which they emerged ordinarily did not bite.

This species of mosquito occurs only in the spring according to reports, (1), (3), (4), (5). In southeastern

1Research Paper No. 630, Journal Series, University of Arkansas.

Arkansas, the larvae were found only during late February and early March in the years 1935 and 1937. On the other hand in northern Alabama, Shields and Lackey collected the larvae from March to late May from the trees in a shallow ground pool. This difference in time of collection may be explained by a possible difference in temperature of the water as well as by differences in the fluctuation of the water levels. It is likely that when the water was at the hatching temperature, each rise of the water level enabled other broods to develop. In southeastern Arkansas the breeding places were not known to have been flooded after the middle of March either year except once during late summer.

That the eggs may remain visible for more than one year in the field is indicated by observations in Arkansas. In the two known breeding places, eggs laid in 1935 had no opportunity to hatch in 1936 because the cavities were not flooded. Furthermore, there were no adults collected near these cavities that year. However, in 1937 larvae were again collected in these places in late February after flooding by winter rains. This delayed development will enable the species to endure unfavorable weather conditions of one or possibly more years.

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A NOTE ON SIGARA GRIFFINI (KIRK.)

H. B. HUNGERFORD, Lawrence, Kansas *

Kirkaldy described **Corixa griffini** from "Lago di Kingora; Harro" in 1899 from material in the Museum of Zoology and Comparative Anatomy at the University of Torino, Italy. He did not mention the number of specimens before him, but besides the material returned to the museum at Torino he retained two female cotypes, which I have seen.

Dr. Jaczewski (1933) examined two type specimens which he secured from the University of Torino and assigned the species to the genus Sigara, a genus in which the males are typically dextral in their abdominal asymmetry. He also compared them with a male paratype of my **Corixa williamsi** and reports that my species is a synonym, and I agree with him. Kirkaldy did not mention whether his male specimens were sinistral or dextral, but did place his species in **Callicorixa,** indicating the absence of a strigil. In describing **Corixa williamsi** I had three males, two of them were sinistral and one dextral, which made it impossible to decide whether the species is typically left or right-sided in the male. I now have a good series of this species from various places in Peru and Ecuador, South America. The collections were made in March, April, May, June, and August, at elevations varying from 1900 to 4000 meters above sea level. Out of 1274 specimens there are 751 males, only 6 of which are dextral. It is quite safe to say that the species is typically sinistral in the male and that the 6 dextral specimens are cases of reversed asymmetry. Reversed asymmetry in male Corixidae was reported by me for **Corisella edulis** (Champion) in 1928, and by Dr. Jaczewski for **Kirzousacorixa femorata** in 1931. I have found it quite common in the genus Centrocorixa and in some other species of Mexico.

* Contribution from the Department of Entomology, University of Kansas.

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